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Nuclear Energy University Programs (NEUP)
Fiscal Year (FY) 2015 Annual Planning Webinar

Nuclear Materials Control and Instrumentation (FC-3)

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Next Generation Nuclear Materials Management – Campaign Mission

- **Mission - Develop innovative technologies and analysis tools to enable next generation nuclear material management for existing and future U.S. nuclear fuel cycles, minimizing proliferation and terrorism risk.**

- **Specific objectives**
  - Develop and demonstrate advanced material control and accounting technologies.
  - Develop, demonstrate, and apply analysis tools to assess effectiveness and efficiency of MC&A systems and guide R&D.
  - Develop tools, technologies, and approaches in support of used fuel safeguards and security for extended storage.
  - Develop guidelines for safeguards and security by design and publish international guidance documents.

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Near Term Objectives

- Support interim storage design activities to advance Safeguards and Security by Design
- International Best Practices Guide for "Security of Extended Dry Storage of Used Fuel" – result of workshop to be hosted by the World Institute for Nuclear Security and IAEA
- Identify and address R&D gaps for security of extended used fuel storage
- Validated model of Electrochemical process for MPACT
- Sensor development for Electrochemical process for MPACT
- Advanced technologies and analysis tools demonstrated for MPACT
- Updated MPACT campaign implementation plan as part of the FCRD program plan and NE R&D Roadmap update

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Long Term Objectives

- **Support DOE Strategy for Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste through Safeguards and Security by Design**
- **Demonstrate next generation nuclear materials management technologies and approaches as opportunities arise**
  - Echem, H-Canyon, bilateral engagements, etc.
- **Address safeguards and security issues associated with technology development in other Campaigns**
- **Support NRC rulemaking through engagement and data generation**
- **International engagement to help influence and support nuclear energy enterprise**

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Nuclear Material Control and Instrumentation (FC-3)

" Of specific interest are technologies and approaches to the safeguarding and monitoring of used fuel dry cask storage and electrochemical recycling technologies. New and improved sensors capable of detecting key elements, isotopes, and process parameters in a timely fashion while handling the harsh environments involved are needed for electrochemical processing. For used fuel dry cask storage we are seeking innovative security technologies that increase effectiveness while at the same time reduce overall costs (e.g., manpower). In addition, modeling tools that can assist in safeguards and security approach development are needed. "

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Nuclear Materials Control and Instrumentation – Recent and Ongoing Projects

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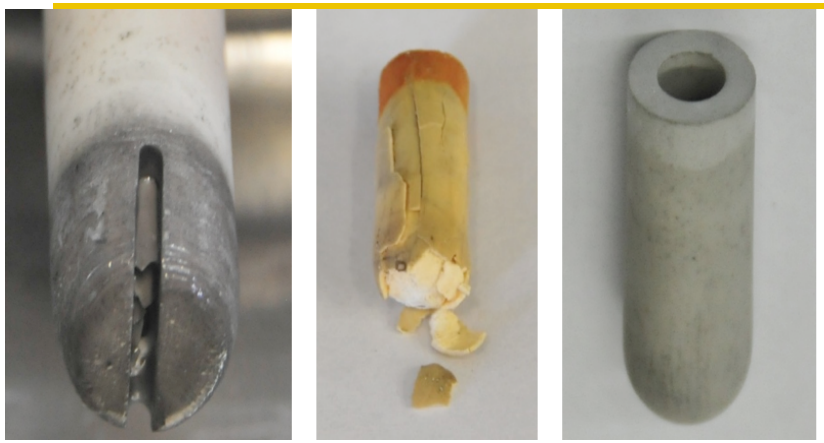
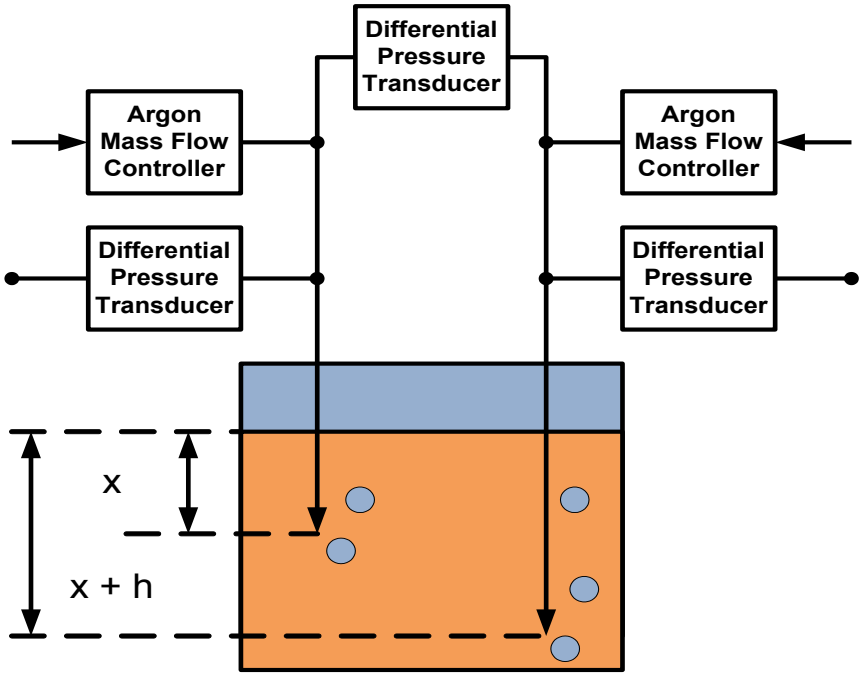
Potentiometric Sensors and Double Bubbler for Electrochemical Processing



- Ion exchange sensor for direct measurement of Pu in molten salt using β”-alumina as carrier material
- Precursors tested – Sr^{+2}, K^{+}, and Na^{+}, with only Na^{+} surviving molten salt test



- Differential pressure sensors for level and density measurement of molten salt

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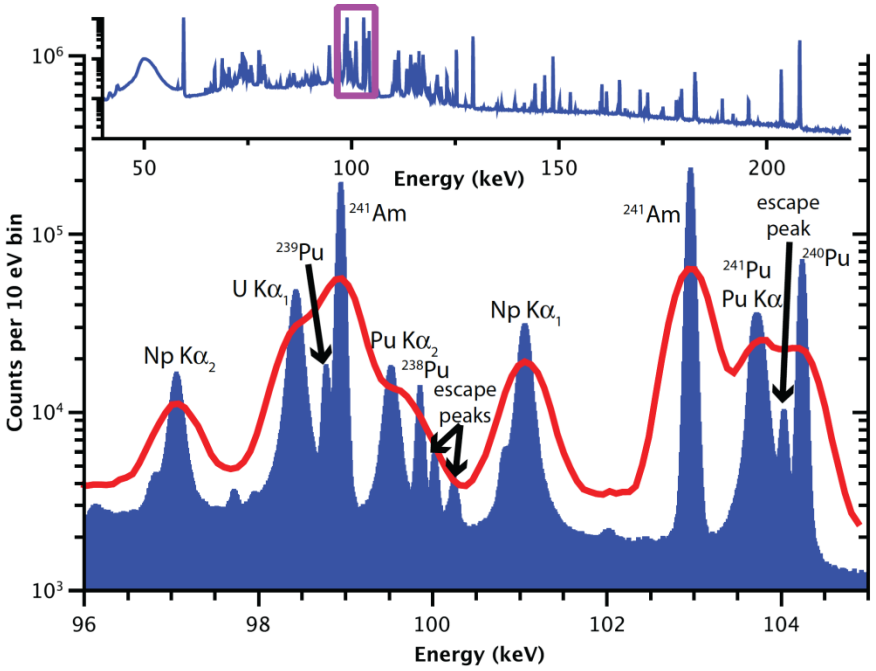
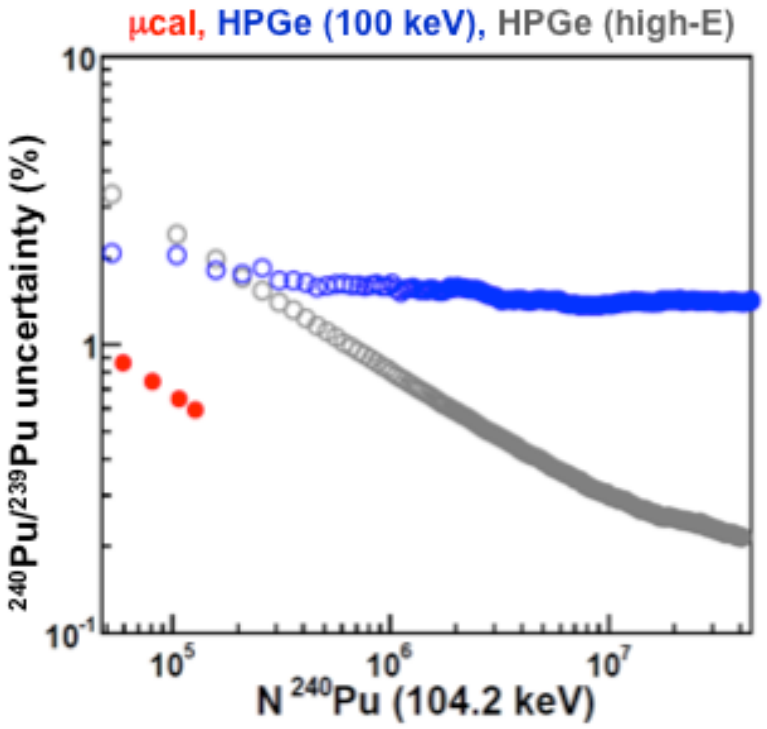
Super-High Resolution Gamma-Ray Spectroscopy



- Significant improvement in the uncertainty of Pu isotopic determination demonstrated

- Cryogenic gamma-ray spectroscopy has demonstrated 10x improvement in resolution over HPGe



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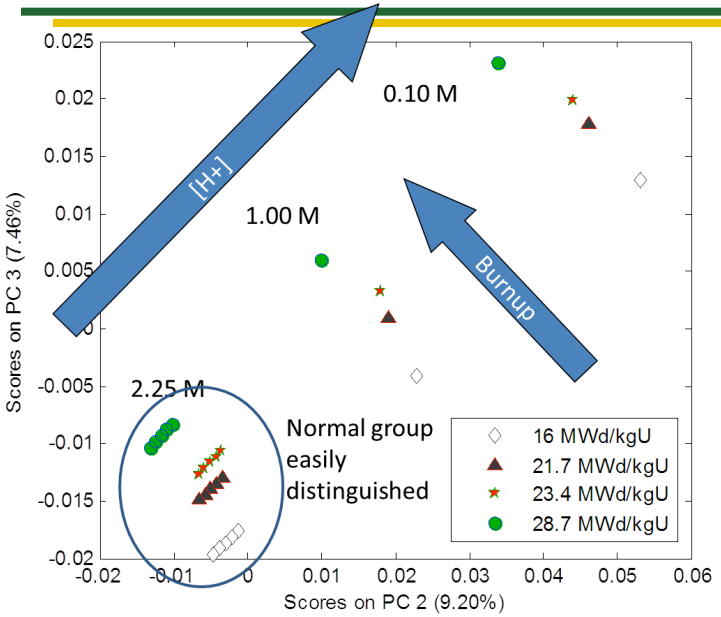
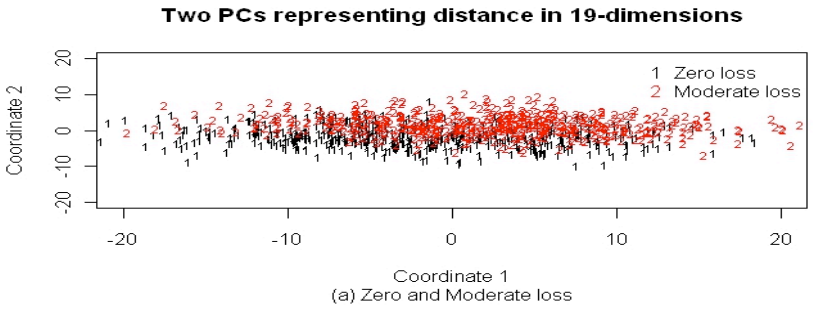
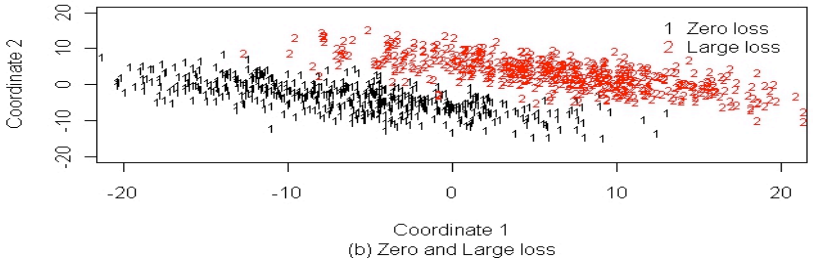
Multi-Isotope Process Monitor and Pattern Recognition



- **Correlation of multiple isotopes via gamma spectroscopy to enable detection of process changes**



- **Pattern recognition of multivariate data – putting process monitoring on equal footing with nuclear material accountancy**



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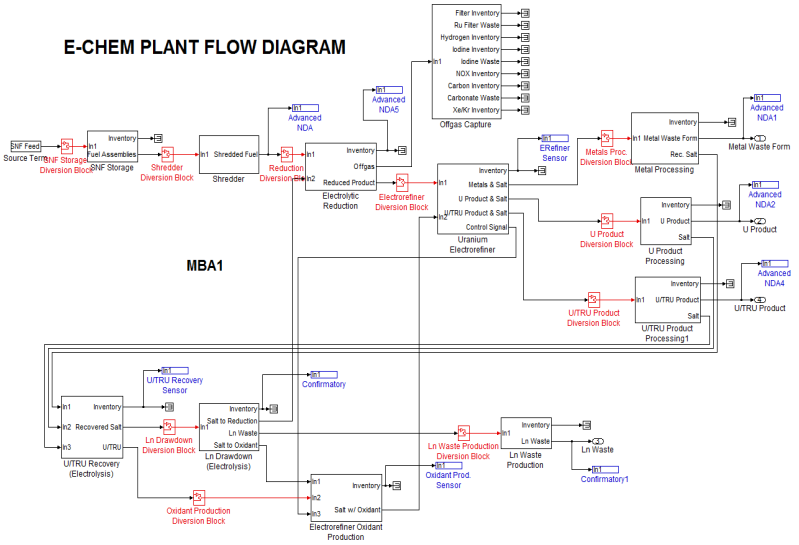
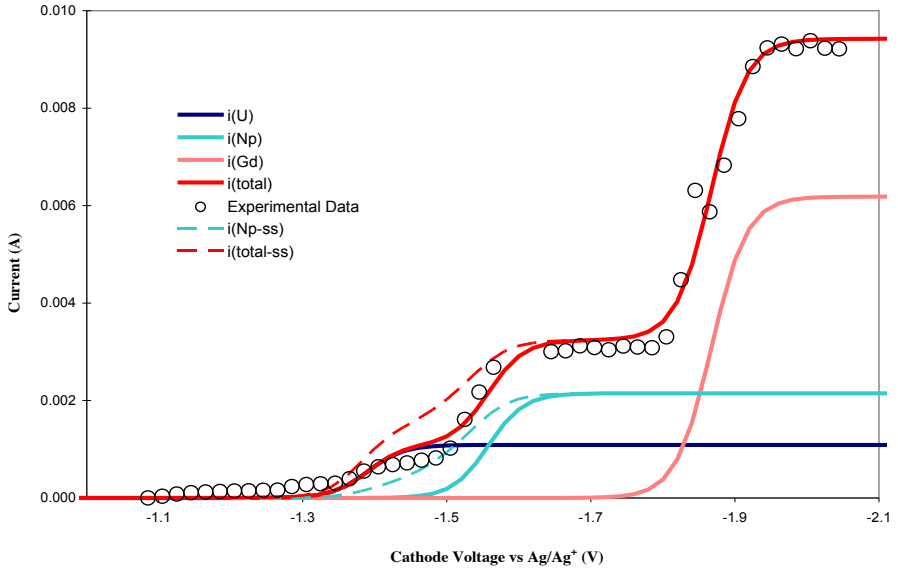
Safeguards and Security Performance and Fundamental Chemistry Models



- Facility model incorporating safeguards and security can be used to conduct system performance studies, including uncertainties

- Fundamental chemistry models can aid understanding in how nuclear material behaves thereby facilitating its management and control



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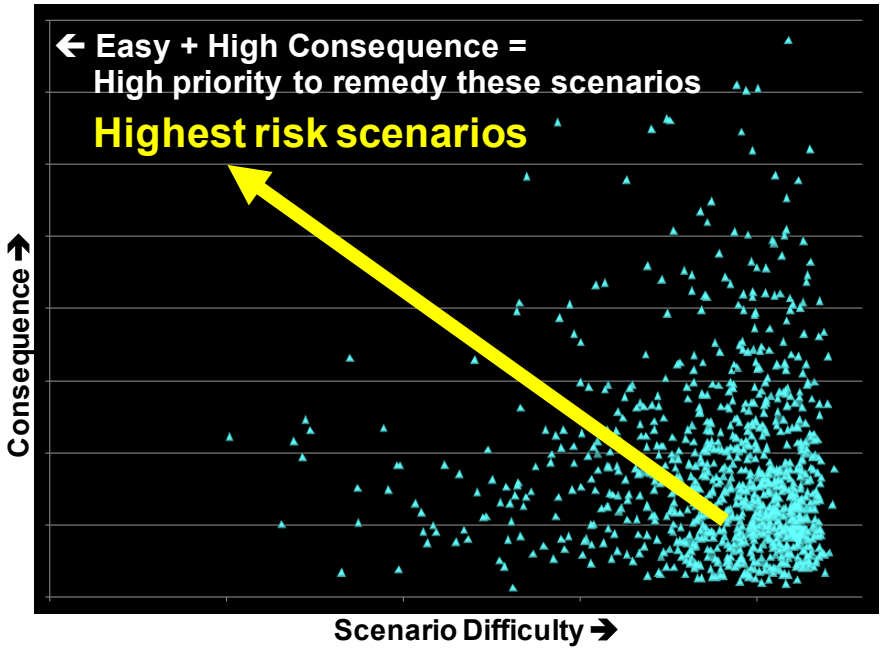
Used Fuel Security and Best Practices for Extended Dry Storage

- Consequence versus difficulty formulation for risk analysis
- Best practices for used fuel security for extended dry storage



- Evaluation of time-dependent used fuel attributes associated with extended dry storage of used fuel